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Applications of TIMS Data in Agricultural Areas and Related Atmospheric Considerations

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While much of traditional remote sensing in agricultural research has been limited to the visible and reflective IR, advances in thermal infrared remote sensing technology are adding a new dimension to digital image analysis of agricultural areas. The Thermal Infrared Multispectral Scanner (TIMS) an airborne sensor having six bands over the nominal 8.2-12.2 m range, offers the ability to calculate land surface emissivities unlike most previous singular broad-band sensors. Preliminary findings on the utility of the TIMS for several agricultural applications and related atmospheric considerations are discussed.

Multiple sets of TIMS data were acquired over a highly agricultural region in the Coastal Plain region of Alabama during the spring for maximum bare soil exposure. However, a significant percentage of the fields were in maturing small grain crops, pasture and recently planted corn and peanuts, allowing study of vegetated areas as well. Both predawn and afternoon data sets were obtained to evaluate minimum/maximum thermal diurnal effects. Similarly each pair was collected at three spatial resolutions (5, 10 and 30 m) to evaluate information content based on cell size and atmospheric thickness.

Multiple applications exist for plant studies, soil studies, hydrologic and topographic concerns, inventory and monitoring of conservation practices, and cartographic features extraction. Diseased, water-stressed and maturing crops will demonstrate a greater range in diurnal thermal response than will vigorously growing non-stressed vegetation. Preliminary investigation sug-

gests that relative canopy density can sometimes be determined and that very low density vegetation may be better detected with thermal data than with reflective data. Combinations of these influences may also be useful in identification of different plant types. Determination of certain soil mineralogy is possible due to emissivity variations between bands. Such changes in mineralogy also enables the detection of erosional features. Other soil factors influencing thermal response include porosity and surface condition (e.g. roughness and crustiness). Hydrologic features from small-scale, near-surface soil moisture through larger-scale stream networks, water bodies and related hydrologic features are important components of the thermal imagery. The effects of elevation and aspect can also be seen through differential heating and cooling. Conservation practices such as terraces, grassed waterways and field drainage ditches can be identified often due to moisture differentials. Through data enhancement techniques (e.g. Principal Component Analysis and high-pass filtering) these conservation practices and other linear features such as erosional gullies, field hedgerows, roads, stream networks and water body boundaries can be extracted for cartographic purposes.

Concerns to remove the atmospheric attenuation from TIMS data resulted in a comparison between radiosonde profile data and model atmosphere data from LOWTRAN-6. Comparison of atmospherically corrected graybody (water) spectra to calculated blackbody spectra indicate that small variations in the concentration of water vapor and ozone between the atmospheric models can cause significant distortion in the graybody spectra. TIMS channels 1 and 4 were most altered since the two channels partially overlay water and ozone absorption bands, respectively. Broad geographical seasonal atmospheric models and radiosonde data collected far from the study site should therefore be used with caution.